

(where this month has been nearly free from such rainfalls), practically the same as those in which excessive rainfalls have occurred in preceding months, discussions of which have been given in the MONTHLY WEATHER REVIEW. It appears, however, that monthly rainfalls of ten inches, or more, have been less frequent in April than in March, especially on the north Pacific coast, where the April records show but one instance of a monthly rainfall amounting to as much as 10 inches, viz., 10.78 at Olympia, Wash., in 1883, and while this limit has not been reached on the central Pacific coast in March, it has been exceeded in April (1880) at both San Francisco and Sacramento, the latter station reporting 14.20. The records of but three stations show April rainfalls in excess of 20 inches, as follows: Brookhaven, Miss., 20.35, in 1874; on the summit of Mount Washington, N. H., 23.41, in 1878; and Jackson, Miss., 23.80, in 1876.

Daily rainfalls in April of 2.50 inches, or more, appear to have occurred with more frequency and over a larger extent of country than in the previous month. This statement, however, does not apply to the east Gulf coast, where they were more frequent at some stations in March than in April. At Vicksburg, Miss., daily rainfalls in April reaching the amount stated have been recorded fifteen times during the past twenty-one years; but of these two occurred in 1869, two in 1872, and three in 1874, there being ten years in which they did not occur. At Galveston, Tex., where the March records gave but

one such daily rainfall those for April show six. At Louisville, Ky., the records show five daily rainfalls under this heading for April, while none have occurred at that station in March, and at Saint Louis, Mo., where but two occurred in March six have occurred in April. Remarkably heavy rains fell in portions of central California, April 20-21, 1880, and during the storm on the dates mentioned measurements of from three to fourteen inches were made at a number of stations, but in no other year do the records show similar rainfalls for that region. The largest amount given for any one day is that reported from Point Pleasant, La., viz., 12.28 inches for April 5, 1885.

As in the months previously considered hourly rainfalls amounting to, or exceeding, one inch have seldom occurred, and the stations reporting same are generally widely separated, being confined for the most part to the Southern States. Since the Signal Office at Little Rock was established, in 1880, four measurements of hourly rainfall in excess of 1.00 inch have been recorded, and of these two occurred in 1882; this station shows the maximum number, notwithstanding that the records at many other stations in the South are twice as long. It would, therefore, seem that these excessive rainfalls occur in the vicinity of Little Rock with uncommon frequency in April.

From the data at hand it appears that the fall of 3.00 in forty-five minutes at Pilot Point, Tex., on April 28, 1879, is the maximum rate that has ever occurred in this month.

## WINDS.

The most frequent directions of the wind during April, 1888, are shown on chart ii by arrows flying with the wind. They were generally northeasterly in the upper Mississippi valley, Lake region, New England, and middle Atlantic states; southerly in the west Gulf states; and variable in other districts.

### HIGH WINDS (in miles per hour).

No maximum velocities of fifty or miles per hour, other than those given in the table of miscellaneous meteorological data, have been reported.

### LOCAL STORMS.

Waterville, Le Seuer Co., Minn.: severe local storms occurred to the northward of this place on the afternoon of the 4th. A large amount of damage was done at Faribault, about fifteen miles northeast of Waterville.

Clarksville, Greene Co., Pa.: the storm during the evening of the 5th was unusually violent, and caused extensive damage in this section.

Sharpsville, Mercer Co., Pa.: the storm of the 5-6th was of unusual severity, and caused considerable damage here and at Mercer, Sharon, and West Middlesex in this county.

Sewickley, Alleghany Co., Pa.: a severe hail storm occurred here about 4 p. m. on the 5th. Numerous windows were broken by the hail-stones. At Coraopolis, in this county, the storm is reported to have been unusually severe.

Perrysburg, Wood Co., Ohio: a severe storm, apparently a tornado, passed south of, and near, here shortly before dark on the 5th, its path being about two miles in length and one hundred yards in width.

Lima, Allen Co., Ohio: the storm of the night of the 5-6th unroofed buildings at this place, and blew down many derricks in the oil fields in Allen, Wood, and Hancock counties.

Connersville, Fayette Co., Ind.: many dwellings and barns were unroofed by a severe storm which passed in a southwesterly direction through this county between 7 and 8 p. m. on the 5th, its path being about eighty rods wide.

Delphi, Carroll Co., Ind.: a violent wind and rain storm occurred here between 5 and 6 p. m. on the 5th. At Sleeth, a small village northwest of here, two houses are reported to have been completely demolished and a train of freight cars

was blown from the track. At Delphi 0.71 inch of rain fell in forty minutes.

Cunningham, Carlisle Co., Ky.: in this vicinity outbuildings, fences, etc., were blown down and some dwellings unroofed by the storm which occurred at 10 p. m. on the 5th.

Mauzy, Rush Co., Ind.: at about 7.20 p. m. on the 5th a tornado formed directly south of this place, distant about three miles, and moved eastward, unroofing buildings and demolishing outhouses. A large amount of damage was done to orchards and forests. The storm was accompanied by hail.

Muskegon, Muskegon Co., Mich.: a rain and hail storm passed over this place during the early morning of the 5th, the hail causing considerable damage to windows and skylights.

Sioux City, Woodbury Co., Iowa: during a severe thunderstorm on the 5th a tornado cloud passed over this city from southwest to northeast; it struck the ground in but one place, where it destroyed a house, then rebounded and moved onward over the western suburbs.

Glenwood, Rush Co., Ind.: a severe local storm passed two miles south of here during the night of the 5-6th, unroofing buildings and causing other damage.

Nashville, Tenn.: very heavy rain fell from 2.30 to 2.45 p. m. on the 9th; from 7.23 to 7.28 the wind blew at the rate of fifty-two miles per hour. Trees, awnings, etc., were blown down by the high wind, and the heavy rainfall flooded cellars and washed out culverts.

Vineyard Haven, Mass.: during the southeasterly gale on the night of the 11-12th a number of vessels in this harbor dragged anchor and some sustained damage.

Charlotte, N. C.: during a thunder-storm on the afternoon of the 19th there was a heavy fall of hail at 6.10 o'clock; some of the hail-stones, which were of irregular form, measured three-fourths of an inch in length. The storm is reported to have been very severe to the east of the city.

Titusville, Fla.: a severe storm, moving from northwest to southeast, and attended by high wind, heavy rain, and hail, occurred on the 19th between 4.23 and 4.48 p. m., during which time 1.62 inches of rain fell. Several boats on the river were capsized and some old buildings blown down. The orange crop sustained serious injury in sections where the fall of hail was heaviest, but fortunately the path of the storm was nar-

row. Much window glass was broken by the hail-stones, which measured from one-fourth inch to one inch in diameter.

Cairo, Ill.: between 9.45 and 10.05 p. m. on the 22d a rain and hail storm prevailed. Vegetables were badly cut by the hail-stones, which measured half an inch in circumference.

Duquoin, Perry Co., Ill.: about 5 p. m. on the 22d a tornado passed through the southern limit of this town, demolishing outbuildings, fences, etc. The storm was of very short duration and moved from west to east.

Mobile, Ala.: a rain and hail storm of unusual severity passed over this city and the adjacent country on the 23d, lasting from 3.35 until 4.30 p. m. The fall of rain amounted to 2.74 inches, 2.60 of which fell in one hour. The streets of the city were flooded to such an extent as to be rendered impassable. Great damage was done to orchards and gardens through a section about a mile wide, extending through Mobile county.

Garden City, Finney Co., Kans.: reports from Coolidge,

Hamilton Co. (in the extreme western part of Kansas), state that a violent hail storm occurred there on the afternoon of the 26th, the hail-stones being unusually large.

Pratt, Pratt Co., Kans.: during the afternoon of the 26th several houses were destroyed at this place by a violent storm. Many persons were badly injured by the flying debris of wrecked buildings.

Wa Keeney, Trego Co., Kans.: reports state that several houses were blown down at Millbrook, Graham Co. (about twenty miles north of Wa Keeney), by a storm which occurred during the evening of the 26th.

Hubbard, Hill Co., Tex.: a destructive tornado is reported to have occurred during the evening of the 26th seven miles south of this place, its path about one hundred yards wide.

#### WATER-SPOUT.

Jacksonville, Fla.: several persons report having observed a water-spout in Saint John's River at 12.25 p. m., 18th.

### INLAND NAVIGATION.

#### STAGE OF WATER IN RIVERS AND HARBOURS.

In the following table are shown the danger-points at the various stations, the highest and lowest depths for April, 1888, with the dates of occurrence and the monthly ranges:

*Heights of rivers above low-water mark, April, 1888 (in feet and tenths).*

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, La. ....	29.9	1	24.8	17, 18, 19	20.5	4.3
<i>Arkansas River:</i>						
Fort Smith, Ark. ....	22.0	30	16.3	7, 8	3.0	13.3
Little Rock, Ark. ....	23.0	15	17.5	29	4.7	12.8
<i>Missouri River:</i>						
Omaha, Nebr. ....	18.0	19	15.9	1	8.8	7.1
Leavenworth, Kans. ....	20.0	21	17.5	1	11.7	5.7
<i>Mississippi River:</i>						
Saint Paul, Minn. ....	14.5	14	14.4	7	3.8	10.6
La Crosse, Wis. ....	24.0	18, 19, 20	14.8	1, 2	4.7	10.1
Dubuque, Iowa ....	16.0	24, 25	20.2	4	6.1	14.1
Davenport, Iowa ....	15.0	28	16.1	4, 5	5.9	10.2
Keokuk, Iowa ....	14.0	30	16.1	7, 8	8.1	8.0
Saint Louis, Mo. ....	32.0	24	23.3	7	18.9	4.4
Cairo, Ill. ....	40.0	3, 4, 5, 6	45.3	30	24.9	20.4
Memphis, Tenn. ....	34.0	10, 11, 12	35.2	30	23.6	11.6
Vicksburg, Miss. ....	41.0	26	44.2	1	32.5	11.7
New Orleans, La. ....	13.0	26, 28	14.9	1	11.4	3.5
<i>Ohio River:</i>						
Pittsburg, Pa. ....	22.0	7	15.9	30	3.3	12.6
Cincinnati, Ohio ....	50.0	1	39.9	30	14.0	25.9
Louisville, Ky. ....	25.0	1	16.4	25, 26, 27, 30	7.1	9.3
<i>Cumberland River:</i>						
Nashville, Tenn. ....	40.0	1	38.1	30	5.1	33.0
<i>Tennessee River:</i>						
Knoxville, Tenn. ....	33.0	1	23.6	30	4.6	19.0
Chattanooga, Tenn. ....	33.0	1	23.6	30	4.6	19.0
<i>Monongahela River:</i>						
Pittsburg, Pa. ....	29.0	7	15.9	30	3.3	12.6
<i>Savannah River:</i>						
Augusta, Ga. ....	32.0	1	21.7	30	8.3	13.4
<i>Sacramento River:</i>						
Red Bluff, Cal. ....	.....	1	5.3	29	2.1	3.2
Sacramento, Cal. ....	.....	25	18.3	8-12	16.3	2.0
<i>Willamette River:</i>						
Portland, Oregon ....	.....	28, 29, 30	9.3	6, 7, 11, 12	4.2	5.1

#### OPENING OF NAVIGATION—ICE IN RIVERS AND HARBOURS.

*Connecticut River.*—Hartford, Conn.: the steamer "City of Springfield," the first boat of the season, arrived on the 1st.

*Hudson River.*—Albany, N. Y.: the ice dam at Barren Island broke during the night of 2-3d, leaving the river open between this place and New York City.

*Lake Ontario.*—Oswego, N. Y.: schooner "Wm. Jannison," from Whitby, Ontario, arrived on the 14th, and reported having encountered but little ice.

Rochester, N. Y.: the schooners "Caroline March," from Port Hope, Mich., and "Eliza Fisher," from Coburg, Ontario, arrived on the 8th.

*Lake Erie.*—Buffalo, N. Y.: steamer "J. O. Gilchrist" cleared for Chicago on the 28th, forcing her way through the ice which still extends as far as the eye can reach.

Sandusky, Ohio: the first boat of the season arrived on the morning of the 9th from Toledo, Ohio.

*Detroit River.*—Detroit, Mich.: steamer "J. C. Gilchrist," from Buffalo, bound for ports on Lake Michigan, passed this place on the 29th, being the first boat of the season.

*Black River.*—Port Huron, Mich.: the river was clear of ice on the 15th.

*Lake Huron.*—Port Huron, Mich.: steamer "Oscoda" arrived from Oscoda, Mich., on the 15th, being the first arrival this season from up the lake.

*Saint Clair River.*—Port Huron, Mich.: floating ice in river 1st to 4th, 8th; steamer "Saint Ignace" arrived from Detroit on the 7th and departed on the 9th.

*Thunder Bay River.*—Alpena, Mich.: the river was clear of ice on the 16th, on which date the steamer "Atlantic" from Detroit, Mich., arrived in bay, but did not reach port, the bay being frozen over, and was compelled to return to Detroit. Steamer "Arundel" from Bay City, Mich., arrived in port at 8.30 a. m., 29th, when navigation for the season was fully opened.

*Strait of Mackinac.*—Mackinaw City, Mich.: the ice boat "Saint Ignace" arrived off Mackinaw Island from Detroit on the 10th, being the first arrival of the season. The ice in the strait began to weaken on the 25th, but it remained firm in the narrows about a mile and a half west of the station.

*Grand Traverse Bay.*—Traverse City, Mich.: ice in the bay moved a distance of about a mile on the 27th, but it was driven back on the 28th; on the 30th drift ice extended about three-fourths of a mile from the shore to open water.

*Lake Michigan.*—Milwaukee, Wis.: at the close of the month navigation was generally resumed, all harbors on the lake being free of ice; the Strait of Mackinac, however, was still closed.

Grand Haven, Mich.: the first boat of the season from Chicago, Ill., arrived during the morning of the 10th.

*Green Bay and Fox River.*—Green Bay, Wis.: ice in river from its mouth to near Lake Winnebago broke up on the 10th. On the 16th the river was clear of ice, and Green Bay was open about one mile from the mouth of the river.

*Lake Superior.*—The observer at Duluth, Minn., reports, under the 30th, "the harbor is nearly clear of ice, and it is expected that the first strong southwesterly wind will break up the ice in the lake."

*Mississippi River.*—Saint Paul, Minn.: the ice dam at the bend of the river below the harbor moved out during the morning of the 9th, and that above the Wabash street bridge moved out about noon of the 10th, leaving the river free of ice. The steamer "Pittsburgh," from Saint Louis, Mo., arrived on the 26th, being the first arrival of the season.

La Crosse, Wis.: navigation was resumed on the 9th; floating ice in river on 11th and 12th.